

Dynamics of mercury in eared grebes on the Great Salt Lake

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Abstract









- In 2004, a U.S. Geological Survey (USGS) and U.S. Fish and Wildlife Service (USFWS) poster generated considerable interest in mercury (Hg) in the Great Salt Lake (GSL). USGS water samples showed high concentrations of Hg and methylmercury (MeHg) in the open water of GSL, and of particular interest was the high percentage of MeHg: normal values are 1% to 5% but in GSL up to 50% or more was MeHg. In addition, USFWS data suggested seasonal accumulation of Hg in brine shrimp and in eared grebes (*Podiceps nigricollis*) staging on the GSL. Bird livers are often the tissue of choice for contaminant studies, but in eared grebes the liver mass changes significantly over the course of a year, complicating data interpretation. Due to uncertainties, a more robust study was proposed to refine mercury bioaccumulation in eared grebes and to evaluate uptake in birds using the open water of the GSL.
- Eared grebes spend three to four months on the GSL during the fall. While on the lake the birds lose their ability to fly and they eat brine shrimp almost exclusively. Both their longevity on the lake and their diet make the eared grebe an excellent choice to study Hg and other contaminants in GSL. In addition, previous data suggested accumulation of Hg at GSL and there is another population of grebes at Mono Lake which may serve as a control.
- In the current study, livers and breast muscle will be analyzed for both total Hg and MeHg and flight and breast feathers analyzed for total Hg only. Livers and muscle will be used to evaluate potential tissue transfer of mercury from organ to organ as well as compare uptake rates and accumulation with species of waterfowl harvested at GSL. Also, some species of birds are able to shunt Hg into feathers: if this is true for grebes it may serve as a protective factor that other waterfowl don't have. Samples of brine shrimp and water were also collected in order to calculate bioaccumulation factors.
- Specific questions to be answered include: 1) does Hg accumulate in birds foraging on GSL, 2) is bioaccumulation in grebes real or simply a physiological response, 3) does feather growth mediate Hg accumulation in grebes, and 4) are other species at risk?

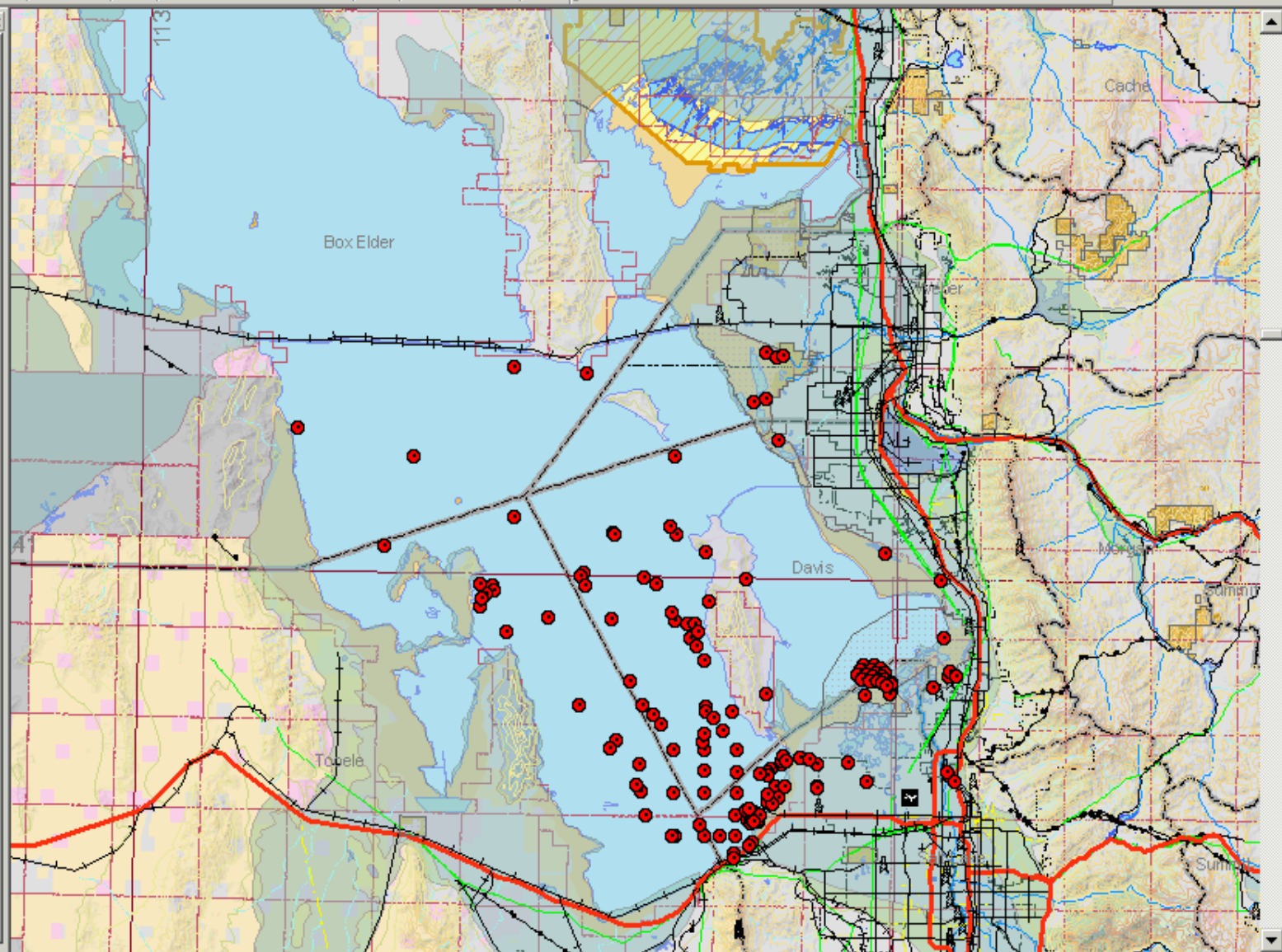
Outline

- Summary of Data collected by FWS
- USGS Water Data from Great Salt Lake
- Waterfowl Advisories
- Eared Grebe Study (GSL)
- Planned and Potential Studies

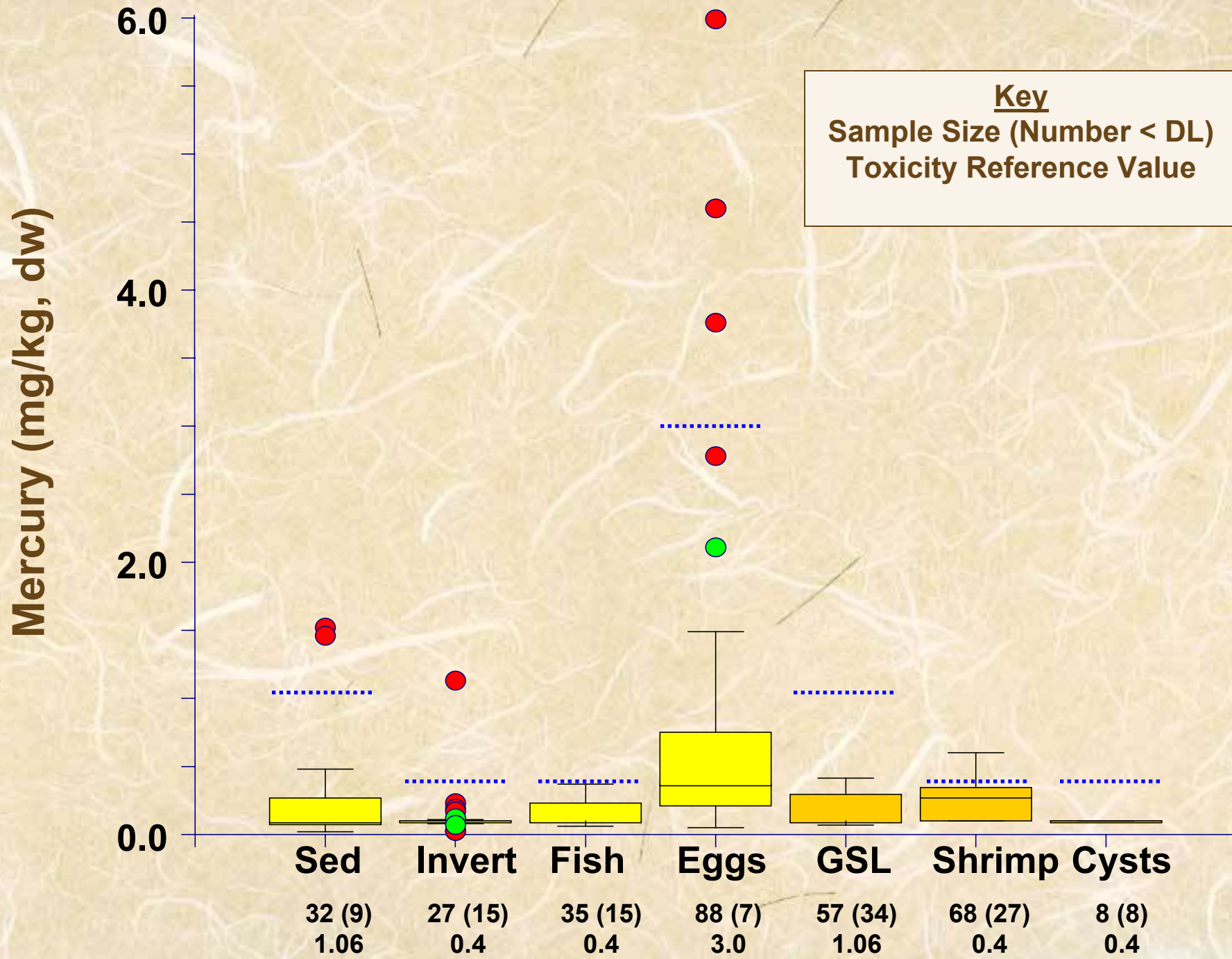
U.S. Fish and Wildlife Service

- Analyzed 400 samples for mercury at GSL
 - 110 sediments (34 in wetlands)
 - 103 invertebrates (25 in wetlands)
 - 35 whole-body fish (32 carp: eagle food)
 - 102 avian eggs
 - 47 avian liver samples (eared grebe)
 - 2 avian carcass

- Layers**
- ☒ Samples
 - ☐ Aromatic_metabolite:
 - 
 - ☐ TPH Events
 - 
 - ☐ Semivolatiles Events
 - 
 - ☐ Dioxins Events
 - 
 - ☐ Aromatics Events
 - 
 - ☐ OCs Events
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 - ☒ Metals Events
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 - ☒ Hypsography
 - ☒ Hydrology
 - ☒ Geology
 - ☒ Reference
 - ☒ Administration
 - ☒ SGID.U100.LandOwners
 - ☒ Images



Display Source Selection



Seasonal Mercury (mg/kg, dw) in Brine Shrimp

0.7

0.5

0.4

0.2

0.0

$N = 28$

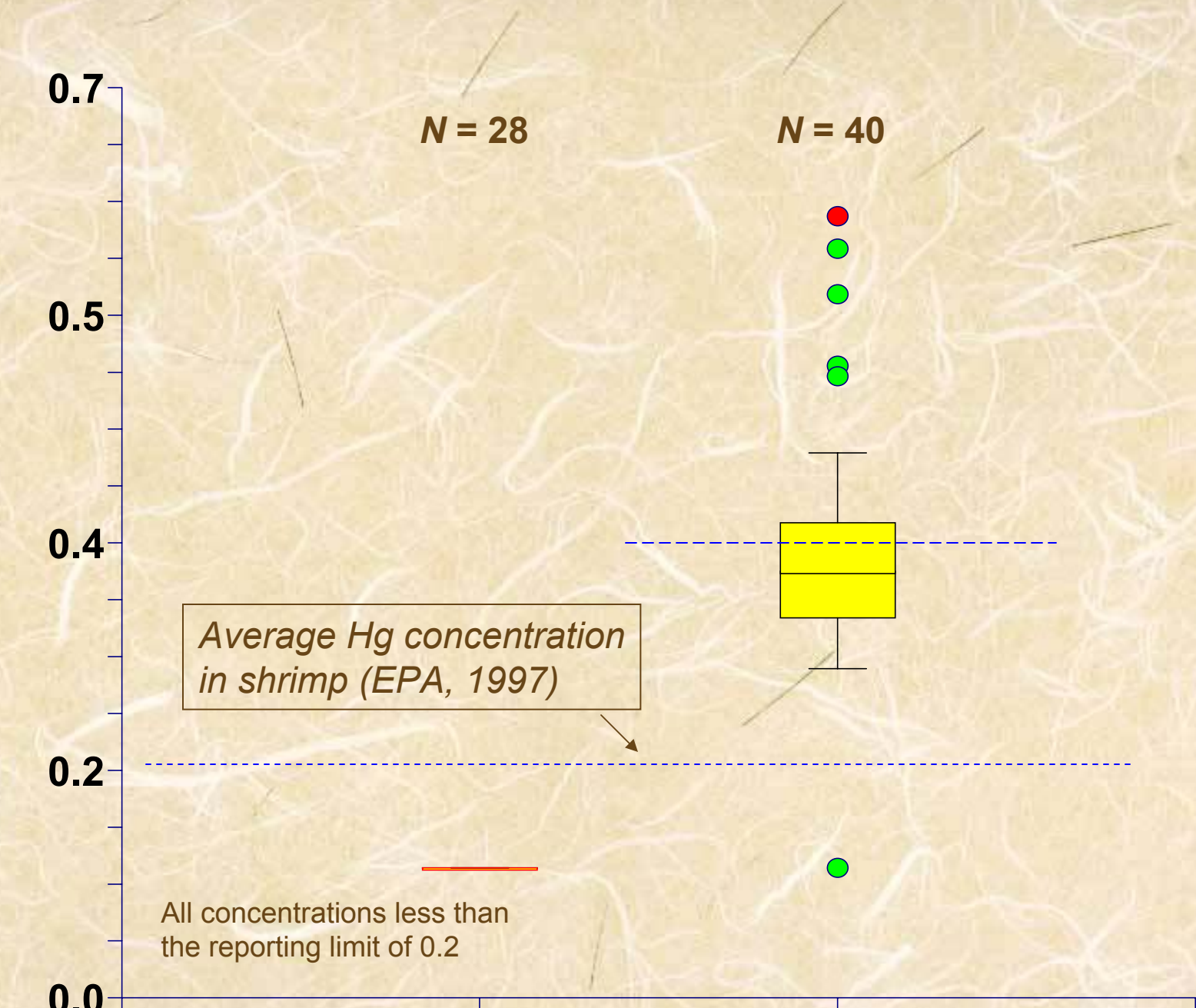
$N = 40$

*Average Hg concentration
in shrimp (EPA, 1997)*

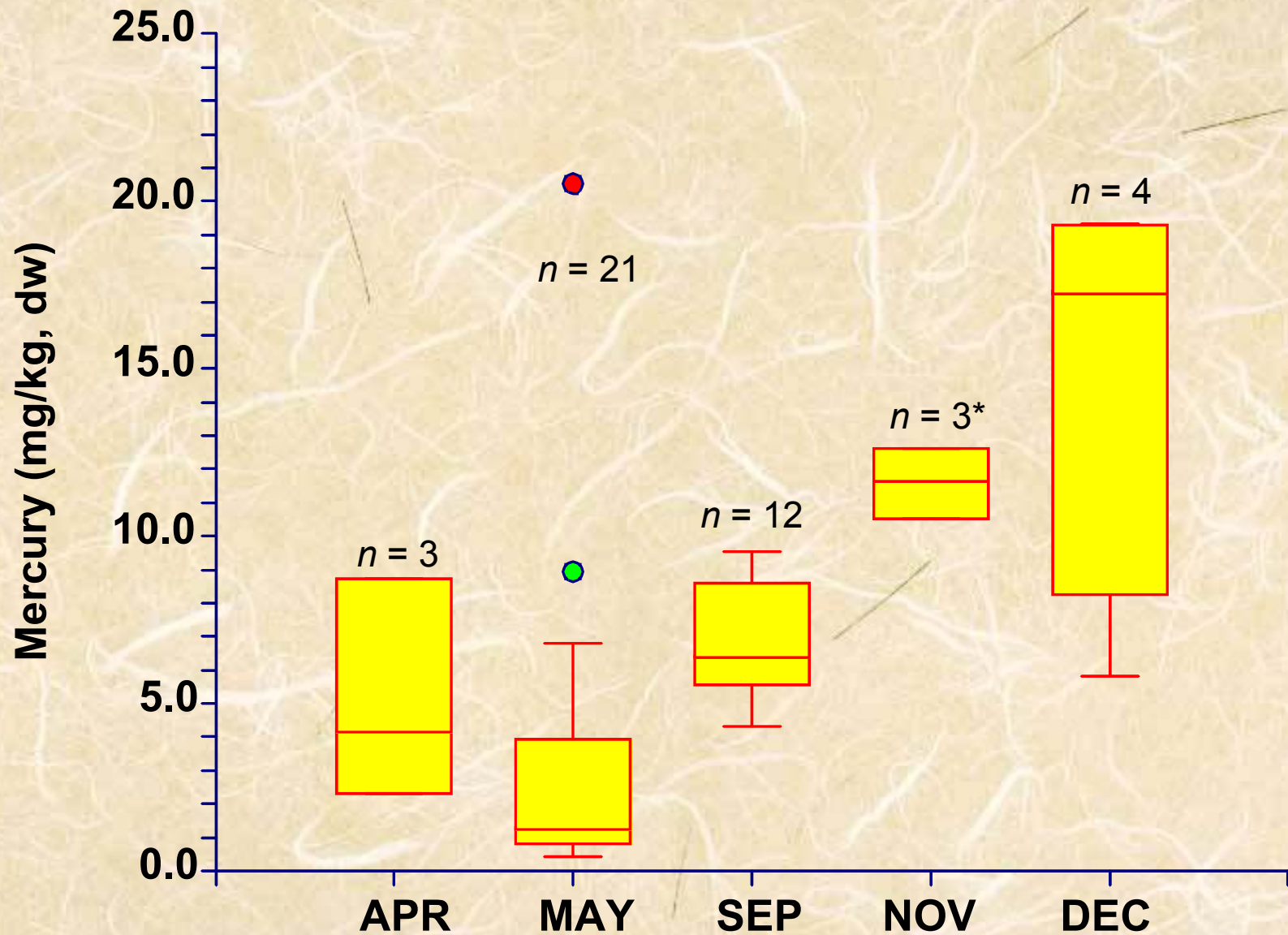
All concentrations less than
the reporting limit of 0.2

Spring

Summer/Fall

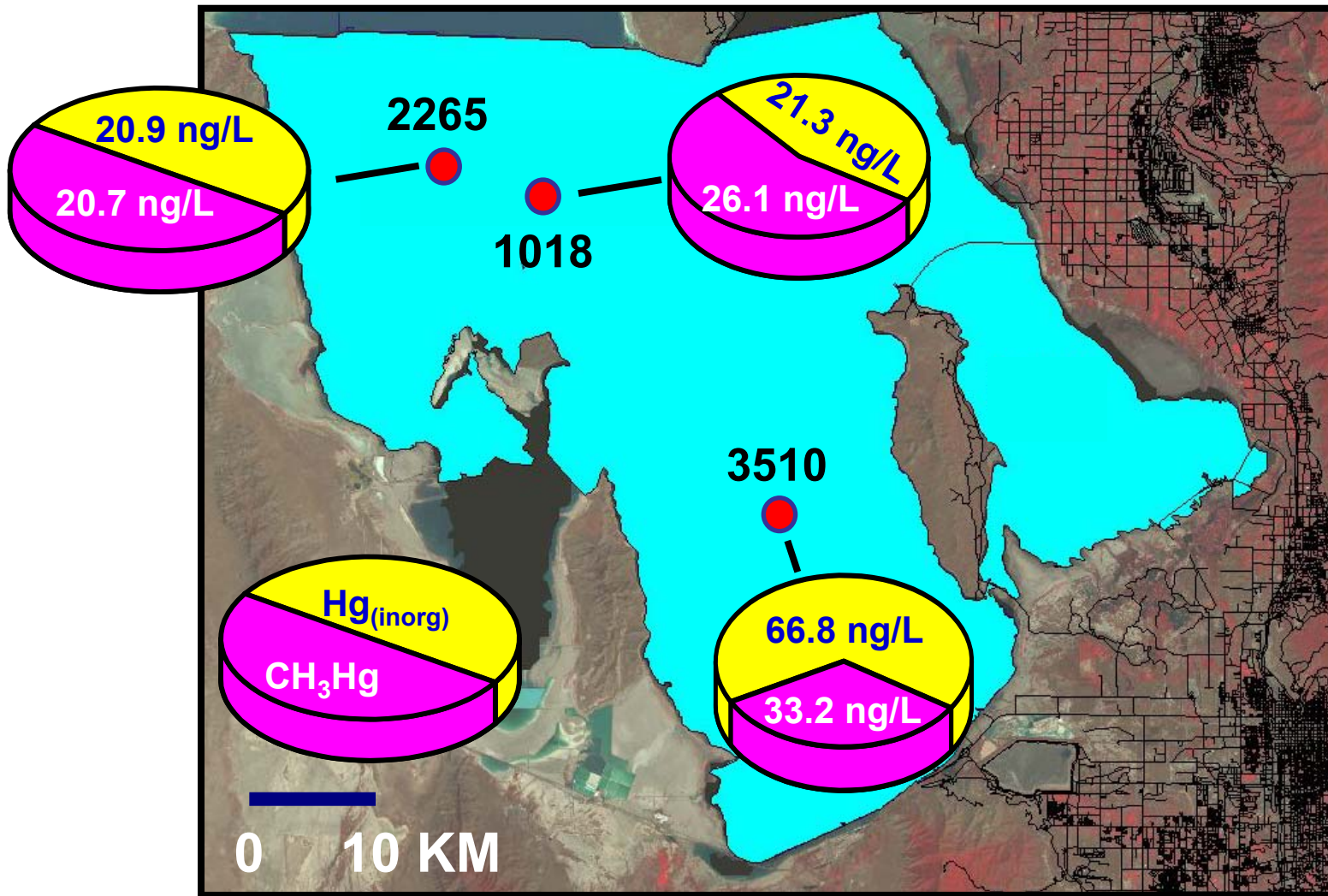


Mercury in Eared Grebe Livers



* Composites of 22 livers

CH_3Hg PRODUCTION IN DBL



Waterfowl Advisories for GSL

- USGS & FWS poster suggests Hg concern
- Archived shovelers and goldeneye tissues from winter diet study reveal elevated Hg in 2004.
- FWS received QRP for eared grebe study.
- State sampled additional birds summer 2005 which led to two advisories (DO NOT EAT).
- State increased sampling efforts in 2006; refined advisories and added cinnamon teal.

Why *Podiceps nigricollis*?

- Eared grebes spend 3 to 4 months on GSL during fall migration
- They eat brine shrimp almost exclusively
- Previous data suggest Hg accumulation
- “Control” population at Mono Lake, CA
- Archived samples

Funded Study FY'06

- U.S. Fish and Wildlife (UT)
- U.S. Geological Survey, Biological Resources Division, U.C. Davis (CA)
- Dr. Joseph R. Jehl

Partners

- U.S. Geological Survey, WRD (UT) (WI)
- Utah Division of Wildlife Resources
- Utah Division of Water Quality

Study Design - Collections

- Eared Grebes (total Hg, some meHg)
 - Livers
 - Breast muscle tissue
 - Feathers (flight and breast)
- Brine Shrimp
- Water (total Hg and total meHg)

Study Design – Timing

Location	Aug	Sept	Oct	Dec
Green River, WY	10			
Mono Lake, CA		7	7	
Great Salt Lake, UT			10	10

Study Design - Hypotheses

- **Ho: Hg concentrations do not differ among locations or stage of migration**
- **Ha: Hg concentrations are higher late staging and post staging at GSL than other migration stages or reference location**
- **Ho: Hg concentrations do not differ among similar migration states**
- **Ha: Hg concentrations differ and therefore temporal considerations of Hg concentrations are important**

Study Design - Objectives

- Establish credible estimates of mercury accumulation in eared grebes attributable to staging on GSL.
- Concurrent collection of water and invertebrate samples to characterize Hg distribution in the GSL system and in eared grebes will provide information necessary for resource managers to establish bioaccumulation and bioconcentration factors for Hg exposure and risk assessment analyses.

Management Implications

- Does Hg accumulate in birds residing on GSL (waterfowl move around more)
- Is Great Salt Lake different (e.g., than Mono Lake)
- Does feather growth 'protect' grebes
- Bioaccumulation: are species that rely upon the GSL at risk (e.g., Wilson's phalaropes)

Efficiencies

- Aliquots of tissues will be set aside for possible Se analysis
- Some craniums will be sent to National Wildlife Health Center for analysis of brain sodium concentrations

GSL Assessment Study

- DWQ submitted proposal to EPA
 - Funding uncertain at this point
 - But desire to piggyback on Selenium efforts

Objectives

- What is the source of the mercury?
 - (is it in GSL or birds bringing it in)
- Recent phenomenon or historical?
 - (sediment cores)
- What are the methylation rates?
 - Rates of transformation from inorganic Hg